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15EE61

Sixth Semester B.E. Degree Examination, July/August 2022
Control Systems

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. With the help of neat block diagram, define open loop and closed loop control system. Mention any four difference between open loop and closed loop control system. **(08 Marks)**

b. Construct mathematical model for the mechanical system shown in Fig. Q1 (b). Draw electrical equivalent network based on force voltage analogy. **(08 Marks)**

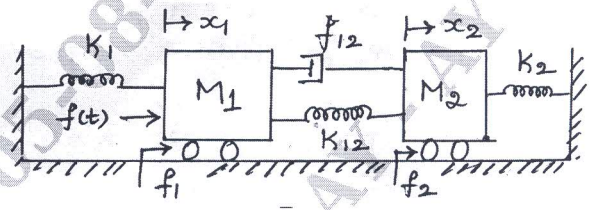

Fig. Q1 (b)

OR

2 a. Draw an equivalent mechanical network using force voltage analogy as shown in Fig. Q2 (a). **(08 Marks)**

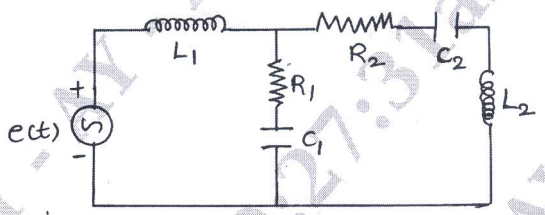

Fig. Q2 (a)

b. For the mechanical translation system as shown in Fig.Q2 (b). Draw the electrical network based on torque current analogy. Write its performance equations. **(08 Marks)**

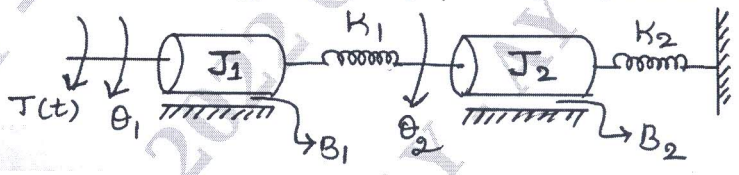

Fig. Q2 (b)

Module-2

3 a. What is transfer function? List the limitations of transfer function. **(04 Marks)**

b. For the block diagram shown in Fig.Q.3(b). Determine overall transfer function. **(06 Marks)**

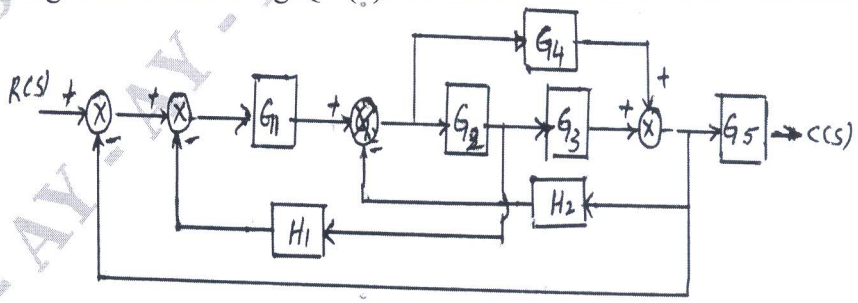

Fig.Q.3(b)

c. Determine transfer function $X_6(S)/X_1(S)$ using Mason's gain formula for the signal flow graph shown in Fig.Q3(c). **(06 Marks)**

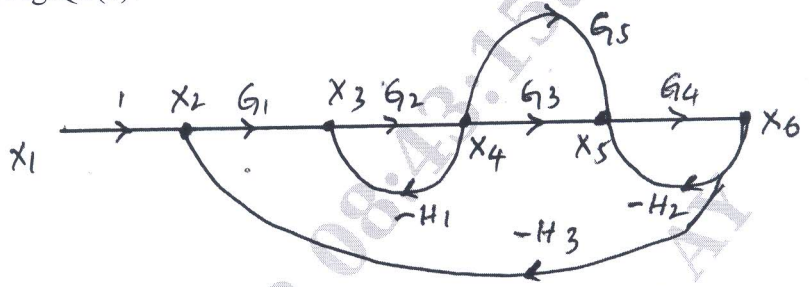

Fig.Q3(c)

OR

4 a. Define:
i) Source and sink node
ii) Loop and forward path
iii) Error signal and primary feed back signal. **(06 Marks)**

b. For the block diagram shown in Fig.Q.4(b) obtain the overall transfer functions. Draw the signal flow graph and verify the transfer functions using Mason's gain formula. **(10 Marks)**

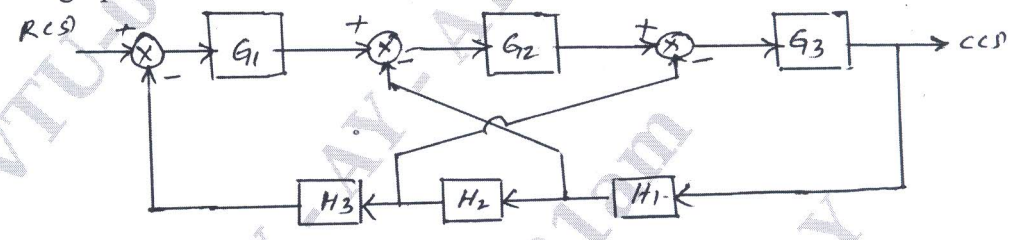

Fig.Q.4(b)

Module-3

5 a. What are necessary and sufficient conditions for a system to be stable according to RH criteria. **(04 Marks)**

b. Determine the stability of the system represent by following characteristic equation, $s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$. **(04 Marks)**

c. The system shown in Fig. Q5 (c) when subjected to a unit step input gives an output response shown in Fig. Q5 (c). Determine the value of K and T from response curve. **(08 Marks)**

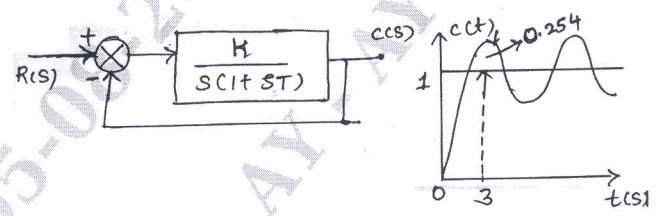

Fig. Q5 (c)

OR

6 a. A system oscillate with frequency "ω" if it has a pole at $s = \pm j\omega$ and no pole in right half of s plane. Determine the value of K and 'a' so that the system shown in Fig. Q6 (a). Oscillate at a frequency of 2 rad/sec. **(08 Marks)**

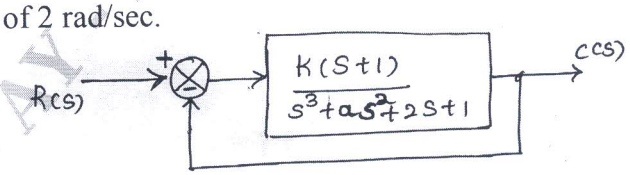

Fig. Q6 (a)

b. For the system $G(s)H(s) = \frac{K}{s^2(s+2)(s+3)}$ find the value of K to limit steady state error to 10 unit when input to the system is $1+10t+\frac{40t^2}{2}$. **(08 Marks)**

Module-4

7 a. Sketch the root locus for unity FBCS having $G(s) = \frac{K(s+1)}{S(s+2)(s^2+2s+2)}$. Mark the salient points. **(12 Marks)**

b. Derive an expression for resonant peak M_r and resonant frequency W_r for a standard second order system. **(04 Marks)**

OR

8 a. A unity FBCS with $G(s) = \frac{10(s+10)}{s(s+2)(s+5)}$. Find gain and phase Margin using bode plot. **(12 Marks)**

b. Write note on: i) Break away point ii) Asymptotes. **(04 Marks)**

Module-5

9 a. The open loop transfer function of a control system is

$G(s)\,H(s) = \frac{1}{s^2(s+2)}$

Sketch the Nyquist plot. Ascertain the stability. **(10 Marks)**

b. Explain giving equations, the function of integral control. **(06 Marks)**

OR

10 a. Explain PID controller and discuss the effect on the behaviour of the system. **(10 Marks)**

b. Discuss the advantages of Nyquist plot. **(06 Marks)**

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